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ABSTRACT

The classroom may be described as an open system of interacting roles, with the function of the instructor described as defining boundaries and regulating transactions across them. In the classroom, the primary task (that which an organization must perform if it is to survive) is to change student behavior in prescribed ways. Boundaries are essential for organization and for the performance of the primary task. The instructor has two major functions with respect to boundaries: first, to define them, specifying what is to be learned, the conditions under which learning shall be demonstrated, and the limits within which acceptable performance falls; and, second, to regulate transactions across them. Boundaries serve as a defense against anxiety in the classroom and divide groups within the class. The greater the uncertainty in the classroom, the greater the flexibility one must be prepared to design into the classroom learning system. Instructors are primarily uncertain about their students, their subject matter, and the interactions between them. Boundary management is crucial in order that students know their tasks and how to accomplish them, and thus take responsibility for their own learning. (JK)

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SOCIOTECHNICAL THEORY: MANAGING BOUNDARIES
TO ENHANCE STUDENT LEARNING

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ABSTRACT

This article examines some of the implications of sociotechnical theory for instructors and administrators in higher education. Concepts that have been used in the past primarily to describe and explain behavior in business, industry, hospitals, and similar organizations, are applied to educational settings and problems. Among the concepts developed and applied in this analysis are those of boundary maintenance and control, defense against anxiety, the effects of uncertainty on instructional (organizational) design, and "quality of life" issues in the classroom. The function of instructors is described as defining boundaries and regulating transactions across them. The major responsibility of students is posited to be learning, a responsibility which they must accept if the system is to accomplish its primary task.

PREFACE

What follows is an attempt to apply sociotechnical theory to the classroom as a learning system. Since this theory is seldom discussed in educational circles, a few comments about its origins may provide the reader in higher education with a context for the ideas developed in this paper.

The genesis of sociotechnical theory may be traced to a small group of psychiatrists, psychologists, and sociologists identified with the Tavistock Institute for Human Relations in London. The institute is an outgrowth of the Tavistock Clinic which was established in 1920 as an outpatient clinic to provide psychotherapy using psychoanalytic methods. Whereas the Tavistock Clinic gives priority to the treatment of individuals, the Tavistock Institute investigates a broad range of issues in the social sciences, focusing particularly on the study of social organizations.

Sociotechnical theory is an unusual amalgam of ideas. Organizational phenomena may be studied at the individual, group, or systems level; and sociotechnical theory incorporates a variety of theoretical positions in an effort to deal with all three of these levels. At the individual level, sociotechnical theory leans heavily on the work of psychoanalysts, particularly the writings of Melanie Kline (1959). To understand better the role of groups in organizations, sociotechnical theory has often turned to the ideas of group therapist Wilfred Bion who wrote an important series of articles in the late 1940s and early 1950s that were originally published in Human Relations and later brought together into a book (1961). More recently, Eric Miller and Albert Rice, in a number of articles and books, have developed some extremely useful notations about groups in organizations (Rice, 1958; Rice, 1969; Miller and Rice, 1967; Rice, 1970). Although this may seem to some a strange theoretical mix, just such a yeasty collection of ideas may be required to help us understand better the complex behavior that occurs in the typical classroom.

From a methodological point of view, there are some similarities between the training methods, which are sometimes broadly classified as sensitivity training, used at the National Training Laboratories in America and the methods advocated by the Tavistock Institute. The apparent similarities break down, however, on close inspection. The difference between the two approaches stands out most clearly over the issue of boundaries, a concept which will be developed more fully in the article that follows. It would perhaps not be too much of an exaggeration if I characterized this difference by asserting the following: while sensitivity training and its various offshoots often seem intent on destroying boundaries, the Tavistock approach values boundaries and tries to preserve their integrity.

The people at the Tavistock Institute were undoubtedly influenced by British social and political experience, an experience which for

centuries nurtured and respected boundaries. As I shall try to show, this emphasis on boundaries is consistent with the approach that I and my colleagues in the Learning and Evaluation Service (L&ES) have taken to the design of learning systems, an approach which also values clearly defined and protected boundaries with respect to tasks, objectives, and technology. Just as boundaries are bulwark against anarchy and chaos in political and organizational life, they serve a similar function in education. Thus, sociotechnical theory provides a psychological and philosophical rationale for some of the ideas which we have expressed in our publications (Davis, Alexander, and Yelon, 1974; Alexander and Davis, 1977; and Davis, 1977). But sociotechnical theory also has much to say about educational leadership, groups, and organizations, topics which have rarely been studied by the staff of L&ES, and it is therefore more broadly applicable than is learning system design.

SOCIOTECHNICAL THEORY: MANAGING BOUNDARIES
TO ENHANCE STUDENT LEARNING

Like other organizations, educational institutions, their classrooms and laboratories, have both a technical and social side, which is to say that the educational enterprise invariably includes both human and technical resources. A basic premise of sociotechnical theory is that for an organization to be most effective, these two sides must be jointly optimized which means that each must fit the demands of the other and the environment in which they are imbedded. Efforts to optimize one side without regard for the other or for the environment will generally prevent the optimization of system performance overall.

The requirement for joint optimization may become clearer if an example is provided. If a technologically imposed learning structure fails to satisfy the social and psychological needs of students, the full potential of the sociotechnical system for effective instruction will not be realized. Consider an effort to introduce some new technology, such as a computer, into a classroom. One effect on the classroom of this new technology will be to change the roles of both the teacher and the students. Depending largely on the mode of computer assisted instruction used, the teacher may be required to change from a provider of instruction to a classroom manager, or from a group leader to a tutor of individual students, or from a channel for communicating information to a designer of instruction. Failure to assess the teacher's willingness to change and assist in

the role transition by providing the necessary skills needed to be effective will jeopardize the whole enterprise. From this example, it should be obvious that analogous considerations apply to students and their changing role when a new technology is introduced.

In this example I have cited possible changes in the social system to make it more compatible with the technical system. But it can also work the other way around. That is, the technical system may be designed or redesigned to make it fit the social system better. If we know, for example, that social interaction facilitates motivation, there is nothing to prevent us from designing a computerized system that permits, or even requires, students to work together. According to sociotechnical theory, we must design each of these systems for the benefit of the other so that they may together perform the primary task most effectively and efficiently.

An important corollary follows from the deceptively simple principle of joint optimization. This corollary holds that there is no single set of structural principles that automatically guarantees optimization. If technology shapes roles and sociopsychological factors constrain technology, the structure of learning systems must necessarily flow from these considerations, not from universal assumptions about the "proper" ratio of faculty to students, for example, or the appropriate size of classes, or philosophical biases in favor of or against "open classrooms" or "closed classrooms," etc.

Another way of stating this corollary is to assert that there is no one best way to design an organization--or a classroom; this principle may be traced to an even more general principle in systems theory: the principle of equifinality which states that in any system

there is more than one way to achieve a given objective. Based on a number of studies in industry, hospitals, and other organizations, sociotechnical theorists have confirmed this basic principle (Burns and Staulker, 1961; and Woodward, 1965). Organizations with very different designs can be highly effective. The optimal arrangement of human and physical resources depends more than anything else upon: (1) the task to be performed, (2) the technology that is to be used in the performance of that task, and (3) the requirement to make the system compatible with the psychological requirements of its participants.

In this article I have set out to describe some of the variables that must be taken into account if the principle of joint optimization is to be implemented in educational settings. The overarching framework for sociotechnical theory is the concept of organizations as open systems. While it is useful to think of organizations in terms of abstract concepts, such as roles and role relationships in open systems, sooner or later roles are operationalized by living human beings who are members of different kinds of groups within organizations. To cope with the complexities of real organizations in operation, sociotechnical theory invokes a number of compatible and complementary theories about individuals and groups, in addition to the open systems model. I will begin by describing the classroom as an open system, after which I will develop and apply a number of other concepts from sociotechnical theory to classroom operations in order to cast light on some of the problems that instructors face as they try to optimize the performance of their classes.

THE CLASSROOM AS AN OPEN SYSTEM OF ROLES

The classroom may be described as an open system of interacting roles. To do so, we must ignore the issue of role incumbents and the extent to which individual differences in personality, motives, and skills influence the overall performance of the system as a whole, i.e., we must treat the system as an idealized abstraction. This turns out to be a powerful way of thinking about classrooms, precisely because it reduces complexity and variability and allows us to speculate about classrooms in general. Let us consider some of the implications of the statement that a classroom may be thought of as an open system of roles.

With the sole exception of the universe, all systems are imbedded in an environment. Depending on their relationship to the environment in which they are imbedded, systems may be described as being either open or closed. Those systems which operate in isolation from their environments are considered to be closed; they do not draw resources from their environment, nor do they discharge products into them. Naturally, closed systems cannot survive forever in this state. Sooner or later they must import materials from their environment or they will decay and disintegrate, i.e., entropy will overtake them.

In contrast to closed systems, open systems engage in a more or less continuous exchange process with their environments, importing materials from them, converting those materials in some way, and exporting them back in a changed form into the environment. All living things are open systems. Organizations are also open systems. Classrooms may be thought of as organizations and, hence, are also open systems.

Obviously, if organizations are to survive as open systems, they must interact with and adapt to conditions in their environments, conditions which are becoming increasingly turbulent and unpredictable. As environmental uncertainty increases, organizations must develop more effective sensory and regulatory mechanisms for dealing with that uncertainty; and they must simultaneously become more flexible in order to accommodate rapidly to unpredictable changes. Thus, many instructors are discovering that many traditional methods, such as the large lecture, are not sufficiently flexible to enable them to assess variability among their students and respond to it.

The concept of open systems is extremely broad and, as we have noted, may be applied to phenomena as diverse as living things and organizations. To pin the concept down, we must look more closely at the component parts of a given system, which in the case at hand is the classroom itself. As I have suggested already, the classroom may be analyzed into roles, by which term we mean a unified and coherent set of expected behaviors, or to quote Katz and Kahan, "role behaviors refer to the recurring actions of an individual, appropriately interrelated with the repetitive activities of others so as to yield a predictable outcome" (1978, p. 189). Without this predictability, the role system could not survive and chaos would reign as, in fact, it sometimes does because role incumbents who bring to the situation their own special needs, motives, and personalities add both spice and unpredictability to the entire system.

Although it may be convenient to think of an open system of roles, the reader will undoubtedly have noticed that one can identify other ingredients that either must be incorporated somehow into the

expected role behaviors or recognized separately. Technology, of course, is one such ingredient. A classroom without some "technology" is almost unimaginable, even though it may be the minimal technology of a log and the Socratic method, it is nonetheless technology. But classrooms also have tasks. While it is possible to imagine the concept of task being incorporated into expected roles of participants in the classroom, sociotechnical theory treats tasks as a separate component of organizations.

A central concept in sociotechnical theory is that of the primary task which is the task that an organization must perform if it is to survive. Organizations normally perform many different tasks, only some of which contribute to the primary task. The primary task of a classroom is to change student behavior in prescribed ways. To accomplish this task, students, teachers, books, materials, electricity, etc., are imported into the system, converted in some way, and exported into the environment. Associated with each of these steps in the overall import-conversion-export process, there are numerous subprocesses, such as selection, training, and evaluation.

BOUNDARIES

It is impossible to think or write about roles, tasks and systems without assuming the existence of boundaries. Boundaries divide the world into meaningful units, separating that which is to be included within a boundary from that which is to be excluded. Of all the attributes that separate humans from other animals, none is more distinctive than our penchant for establishing boundaries. We bound time into seconds, minutes, and hours. We bound knowledge into facts, concepts, and principles which are themselves ways of bounding the

experiential data that floods over us in a lifetime. We bound territory, tasks, and technology. Indeed, a great deal of human knowledge consists of nothing more than the development of sophisticated, reliable, and valid boundaries, and much of what passes for education involves teaching students to discriminate finer and finer boundaries. Thus, the nervous system is divided into the central and peripheral systems; the central system is divided into the brain and spinal cord; the brain is divided into the cerebrum, cerebellum, and brain stem; the cerebrum is divided into two hemispheres separated by the corpus callosum; and so on and so on, until we have subdivided the brain and subdivided its functions by establishing one interlocking set of boundaries after another.

Without the differentiation that boundaries make possible, the world as we know it would be inconceivable; we would all regress to the "booming buzzing" confusion of the newborn, back even to the point where we could not distinguish between the self and the rest of reality, because that may be the most primitive of all the boundaries that humans draw.

BOUNDARIES AND THE ROLE OF THE TEACHER

Boundaries make all organizations, not just organizations but organization, possible. The classroom must be bounded or it cannot perform its primary task. A decision must be made as to when and where the class shall meet, who shall be included and who shall be excluded, what shall be studied and what shall not be studied, what knowledge shall be evaluated and what shall not be evaluated, when it will be evaluated and when it will not be evaluated, and so on. The role of the teacher is to manage classroom boundaries in order

to insure that the primary task of the class is accomplished. In the best of all possible worlds, the instructor would devote most of his or her attention to defining and regulating transactions across the boundaries, leaving students free to perform their primary task. Unfortunately, as we shall see, students often enter the learning situation with dependent assumptions which interfere with this process and which must be changed.

I shall try to demonstrate that if the instructor abrogates responsibility to manage classroom boundaries the resulting anxieties may prevent the system from accomplishing its primary mission and may even destroy it.

To illustrate how the elimination of boundaries provokes anxiety, we need only consider the procedures typically used in sensitivity training. Ten people gather together in a room. Initially, they look to their designed leader for guidance, for some agenda, but he refuses to supply it. The members of the group may never have seen one another before; they may not know each other's names. Who are they? Why are they here? What are they supposed to do? Thus, boundaries are eliminated or blurred. Anyone who has participated in such sessions will testify to their power to elicit anxiety. Even if one does not feel the anxiety oneself, it is palpably present in others in the group. And now we must note a paradoxical feature of sensitivity training: the elimination of boundaries is essential for the achievement of the primary task. By destroying boundaries, the group shifts its attention from subject matter to process, from "thinking about" interpersonal processes to living them. The group becomes the source of the data which it will process and digest.

Thus, the basic strategy in sensitivity training is to manage boundaries by selectively eliminating them to generate anxiety. When the primary task is to improve the students' interpersonal skills, this procedure may be useful. But it is not a good paradigm for teaching most subjects; the absence of boundaries delays and may even prevent learning that meets the conditions of the primary task. In most classroom settings anxiety, which has no clear and useful purpose, may only tear the group apart or cause it to devote most of its energy to the tangential work of improving interpersonal communication.

What precisely does it mean to say that the role of the instructor is to manage classroom boundaries? The instructor has two major functions with respect to boundaries: (1) to define them, and (2) to regulate transactions across them.

The existence of boundaries implies a discontinuity of some kind. Measurements are always made at the boundaries. Indeed, the predominant mode of evaluation is to look for variances at the boundaries. We declare students to be late, absent, falling behind, competent, etc., by reference to boundaries. The first task of the teacher, therefore, is to define the boundaries. Among the most important boundaries established for students are those that divide the subject matter into that which must be mastered from that which need not be mastered. A well-defined objective defines not one, but three boundaries. The first specifies what is to be learned. The second bounds the conditions under which the learning shall be demonstrated. And the third specifies the limits within which acceptable performance falls.

Although it is extremely important to define boundaries, it is equally important to control transactions across them. The instructor must insure that the boundaries are maintained and that variances are noted and corrected. Thus, for example, the instructor must protect the boundaries of the class in time and space to insure that other activities do not encroach upon them.

Although boundaries are essential to the accomplishment of the primary task, they almost always inhibit the free flow of communications across them. One of the instructor's principle functions is to share knowledge and experiences across boundaries to insure that total organizational performance does not suffer. If students can be given greater responsibility for managing their own learning experiences within established boundaries, the instructor may then concentrate more of his or her energy on transactions across the boundaries to eliminate unnecessary redundancy in the curriculum, for example, or arrange for needed learning resources.

BOUNDARIES AS A DEFENSE AGAINST ANXIETY IN THE CLASSROOM

Organizations frequently evolve structures and procedures that help defend their members against anxiety. Hospitals, for example, have developed a variety of sophisticated techniques to help nurses cope with the stress of caring for sick and dying patients. Menzies (1960) has pointed out that the core of the anxiety problem in hospitals lies in the relationship between nurses and their patients and preventing the formation of attachments. To manage this problem, hospitals invoke a variety of tactics, many of which the outsider deplores. Contact between a given nurse and a given patient, for example, are restricted by rotating work schedules; relationships

are depersonalized by referring to patients by number and disease categories ("the cancer patient in bed #35"); nurses are encouraged to deny their feelings and control their emotions; task performance is ritualized to relieve nurses of all responsibility for making decisions, e.g., everyone is awakened at a fixed hour regardless; nurses are encouraged to distribute responsibility among themselves and not to assume it on their own; and finally, nurses are required to move decisions upward in the hierarchy, usually to the doctor.

Classrooms, like hospitals, provoke large amounts of anxiety for both students and instructors which must be controlled if it is not to interfere with the primary task. This anxiety is normally elicited by: (1) threats to boundaries, and (2) evaluation at the boundaries.

Consider first the proposition that if boundaries are ambiguous or are breached, the entire learning enterprise may be jeopardized.

The most obvious boundaries are established by administrative action or by tradition. Thus, classes are scheduled for fixed periods of time and predetermined locations. Students are not permitted to enroll in overlapping classes. Only one class is assigned to a given classroom for any given time slice. Under normal conditions, teachers would not think of crossing the boundary into another teacher's class without obtaining prior permission. Students are required to respect classroom boundaries. In some educational settings, boundary management by central authority extends to the objectives that are taught, to the syllabi and texts that are used, to the examinations that are given, and so on. When these boundaries are not prescribed, the instructor must define them in order to forestall the emergence of

anxieties, for whenever students do not know what is expected of them, they become justifiably concerned because, as I will note shortly, they expect to be evaluated at the boundaries and evaluation threatens deeply held convictions about one's self-worth.

Curricular boundaries help to protect the faculty from anxiety as the following example illustrates. There have been periodic proposals at Michigan State University to shift from the so-called term system, which lasts about 10 weeks, to the semester system, which lasts about 15 weeks. Although it is generally agreed that the semester system would provide a more sustained in-depth learning experience for students, the proposed change would so dramatically alter existing boundaries that it inevitably provokes great anxiety and resistance on the part of faculty. Literally thousands of courses have been designed to fit into a 10-week time slice and, with great effort, over a period of decades, interrelated with one another. The existing boundaries define for the faculty precisely where their responsibilities lie and faculty members have adapted their lives to them. When the boundaries that separate all of these courses are threatened simultaneously, it is little wonder that faculty anxiety increases to the point where no matter how attractive the alternative it proves unacceptable in the end.

The classroom and curricular boundaries which I have just cited are only the more obvious ones. There are other equally important but more subtle boundaries. Consider, for example, role boundaries. We have already noted how roles make behavior predictable, and it is this predictability that helps to control anxiety. When instructors behave like students, or expect students to behave like teachers,

traditional role relationships are disturbed, anxieties surface, and the system is threatened. Students are confused with good reason, and frustrated when a teacher asks, "Well, what'll we do today?" or a class is described in the catalog as being about history but the instructor runs it like a sensitivity group, or turns his or her class over to one or more students for them to monopolize.

The phenomenon of transference greatly complicates role relationships in the classroom. Whether transference supports or interferes with the accomplishment of the classroom's primary task depends primarily on the instructor's recognition of it and the way in which he or she exploits it. Transference may be used to enhance student growth and development or it may be used to satisfy, first and foremost, the instructor's needs regardless of the consequences for the student.

In 1905 Freud defined the transference process in the following terms:

"They (transference phenomena) are new editions or facsimiles of the impulses and phantasies, which are aroused and made conscious during the process of analysis. They replace some earlier person by the person of the physician. To put it another way a whole series of psychological experiences are revived, not as belonging to the past but as applying to the physician at the present moment."

Although Freud was interested primarily in the manifestation of transference during psychoanalysis, it is widely recognized that it influences all human relationships. Whenever we react to some person, our behavior is affected by associations between persons in our past

and those now present. Students, for example, often unconsciously associate their early experiences with parents, associations that may be loaded with emotion, conflict, and anxiety, with their teachers in the here and now.

If a student's experiences with his or her parents has, on the whole, been positive and healthy, transference may be used to increase motivation and commitment to the subject matter. When students love and respect their parents, they may transfer those feelings to instructors who may then use this transference to help students establish their own identity and direction.

But there are dangers in this situation as well as opportunities. The emotional relationships between student and teacher may revitalize strong feelings of sexual attachment to a parent. Within the family, these attachments are normally constrained by firm boundaries and the sanctions against crossing these boundaries are severe and almost universally enforced. No such constraints inhibit intimate relationships between teachers and students; the boundaries that divide parent-teacher roles and son or daughter-student roles blur and both sides may be tempted to exploit the confusion. The emotional and work life of student and professor become so hopelessly entangled that the primary task of learning becomes secondary or is ignored altogether.

Another major source of anxiety in all educational settings is evaluation. Evaluation is anxiety provoking because it is linked to deeply held convictions about self-worth and provides the basis for a wide range of social decisions that may confirm or refute beliefs about oneself.

For the student, evaluation is often assumed to be correlated with intelligence which is highly valued in this society. Grades

are a factor in the decision to hire a graduate, admit him or her to graduate school, etc.

For the teacher, evaluation is a judgment about job performance which is also related to the issues of self-worth and competence. Jobs are one of our most important anchors in an unstable world, and faculty evaluation by students threatens to set instructors adrift. The decision to become a teacher requires that a person make a heavy emotional and motivational commitment to an area. Every instructor has paid a high price in time and foregone income to build his or her skills in the subject matter which he or she teaches. To be judged unsatisfactory after so great a personal investment can be devastating to the individual psychologically. But what is generally threatening is that in many cases, the evaluations are used in decisions about promotions and salary increases.

BOUNDARIES THAT DIVIDE GROUPS WITHIN THE CLASS

Group life is enormously complicated by two facts. First, individuals in a group invariably hold membership in other groups. And second, there is a sense in which every group is actually made up of many different groups. Under conditions such as these, the boundaries that separate groups are often ambiguous.

Work and Sentient Groups

Let us consider the first proposition, namely, that people hold membership in many different groups.

Groups come together for some purpose, i.e., to achieve some outcome. If groups are to meet their objectives, cooperation among the members is essential. Within limits, the students in a class, for example, must know what to expect of the teacher and of one another. The class must be organized and structured to insure that

order will prevail. Viewed from this perspective, the class is what Bion calls a "work group" (1961). In work groups, the climate is one of rationality and order. The work group, to use Bion's phrase, is rooted in reality and this tie to objective fact and rational thought processes provides the basis for cooperation as to purpose and methods.

But the fact that an individual belongs to a work group does not mean that he or she has any emotional investment in that group. In large classes students may never come to know one another as individuals or feel any loyalty whatever to the group. Classes of this kind are relatively free of sentience, emotion, and commitment. On the other hand, people in small classes often feel that they belong to a group to which they owe some allegiance. Thus, work and so-called sentient groups sometimes overlap and they may even be almost completely coextensive, as in a family-owned business.

When boundaries between sentient and work groups break down, the resulting ambiguities and confusions often interfere with the performance of the primary task. One of the major sources of difficulty in a family-owned business, for example, lies in boundary maintenance, in separating family leadership based on seniority, from business leadership which must be based on ability. Almost everyone would agree that it is a good thing for students and teachers to develop some sentience, sensitivity, and feeling toward one another. But if the teacher allows those feelings to interfere with the proper performance of the primary task of the work group, then the work group itself will be threatened because, by definition, if the work group cannot perform its primary task, it cannot survive. Thus, although it may be a good idea for a college professor to have a beer with

the graduate students, the professor would be well advised to not allow sentience to interfere with evaluation decisions in the work group.

A certain amount of overlap between sentient and work groups is good because sentience creates a climate of trust and openness in which people communicate more openly and freely. But, sentience often obstructs change because people find such deep satisfaction in interpersonal relationships that they may resist innovation in the work group that threatens to disrupt the sentient group. Every graduate professor has known students who became so attached to their peers and professors that they found it impossible to get on with the task of earning their degrees.

For these reasons, it is essential for instructors to understand the nature of the groups in which individuals in their classes hold membership and to control the boundaries that separate them. The effective teacher is able to develop both sentient and work groups but preserves their boundaries.

Assumption Groups

In his studies of therapeutic groups, Bion observed that the work group undertakes its task against a changing backdrop of tacit assumptions and emotions that are not as clearly articulated, rational, or orderly as those that govern the work group. When a group is dominated by one of the so-called "basic assumptions," it behaves "as if" the assumption were true, and this in turn shapes its approach to its primary task.

In the typical classroom, the teacher is the nominal leader of the work group. But as the group shifts from one basic assumption to another, leadership may change with it. One of the basic assumption

groups identified by Bion, for example, is called a "fight-flight group." When the basic assumption of fight-flight prevails, the group behaves as if it has met to attack someone or flee from someone. It is not at all uncommon for instructors to be the target of their students' wrath when they are perceived to be making unreasonable demands of them or unfairly evaluating them. When this happens, the leadership of the fight-flight assumption group is generally vested in one or two students who direct the attack, while others support them. Sometimes the instructors themselves mobilize the fight-flight assumption in order to attack the central administration, other faculty, classes, or institutions, etc.

Obviously, the "basic assumption group" may either divert the group from its primary task, or it may be used to reinforce the effort of the group. In the examples cited above, the fight-flight assumption would probably interfere with the accomplishment of the primary task. But under the appropriate conditions, the leader may bring basic assumptions into harmony with the primary task and enhance the work of the group. Another of Bion's basic assumptions, for example, is dependency. A "dependent assumption group" behaves "as if" it will be protected by one individual acting as its leader who will provide security, guidance, and direction. When the assumption of dependence prevails, the group behaves as if one of its major functions is to be dependent. Under these conditions, the group expects the leader to know precisely what needs to be done, to confidently point the way to be followed, and exercise full leadership in getting there. The members behave as if they were helpless and unable to move forward on their own. Sometimes teachers use the assumption of dependence to aid the

achievement of their primary task, and there are institutional settings, such as hospitals and nursing homes, in which the basic assumption of dependence is almost essential to the work of the group.

There are, however, two major problems with encouraging the assumption of dependence in education. First, no instructor can ever live up to the expectations of a dependent group. Sooner or later, the best organized instructor is certain to make a mistake or offer an incomplete or unsatisfactory answer to a question. When that happens, disillusionment sets in and the group may begin to look for another leader or shift its basic assumptions. But second, the ultimate objective of all education is to make students into independent learners, and mobilizing dependency discourages the accomplishment of the group's most fundamental mission.

The third and last of Bion's "assumption groups" behaves as if its problems can be solved or its mission can be accomplished through "pairing." The most notable feature of pairing is the sense of expectations and promise that is stimulated when two individuals in a group engage in an intimate intellectual exchange, and the members of the group share in the excitement of potential discovery and creation. Although there is an obvious analogy between the pairing assumption and myths of expectation and hope based on sexual union and birth, Bion does not limit this assumption to pairs of the opposite sex. On the contrary, the "pairs" may simply be small groups of individuals of whatever sex who lead the group to anticipate new solutions. Classes are sometimes broken down into small groups (or pairs), for example, which then reassemble later and share their insights. If the basic assumption of the group is compatible with this process of

pairing, the experience is apt to be more satisfying than if some other assumption, such as fight-flight, is dominant. Therefore, to make such a procedure most effective, the instructor should mobilize the assumption of pairing before using it.

TASK STRUCTURE AND THE DESIGN OF LEARNING SYSTEMS

As I pointed out in the introduction to this paper, sociotechnical theory postulates that there is no one best way to design organizations. This proposition applies to the classroom as much as it does to other types of organizations that are more commonly studied by sociotechnical theorists. The way in which the classroom learning experience is structured will depend upon the same variables as those that affect structure in other types of organizations, i.e., the nature of the inputs into the system, conversion process demands, and the psychological requirements of students and instructors. The issue of "psychological requirements" has already been addressed when I discussed the need to control anxiety in the classroom through boundary definition and defense. But what of the other two dimensions? Does sociotechnical theory provide any guidance with respect to the structure of classroom learning systems when some of the characteristics of the inputs and conversion processes are known? Although sociotechnical theorists have not addressed this question directly, there are a number of potentially useful ideas scattered throughout the literature which may be applied to the issues under discussion (see particularly Perrow, 1967, 1970; and Gailbraith, 1970).

As a point of departure for this discussion, consider the following general principles: the greater the level of uncertainty with respect to either the inputs (student characteristics) or the

conversion process (subject matter--instructional design), the more flexible (less rigid) the structure of the learning system must be.

I mean by the term a "flexible structure": (1) that the learning system has the potential for high variability with respect to the methods used to teach students and processes used within different methods to gain attention, reinforce behavior, provide feedback and guidance, etc., and (2) that the learning system is readily adapted to changing conditions.

This heuristic is easily understood at the intuitive level.

Thus, it seems obvious that as our uncertainty increases, the systems we design to cope with uncertainty ought to have a substantial amount of flexibility built into them. A system that is too rigidly prescribed may be unable to deal with the exceptions that uncertainty implies. But how are we to translate this generalization into more concrete terms that may guide decisions about learning system design?

Classroom Structure and Student Characteristics

To begin, we must define more precisely what it is that instructors are uncertain about. They are uncertain primarily about their students, their subject matter, and the interactions between them.

With respect to the student characteristics, two major issues arise. First, there is the question of the extent to which the properties of students as learners are understood by the instructor or designer of the learning experiences. Clearly, if the instructor does not understand how students learn best his or her subject matter, i.e., how to achieve the stated objectives of the course from the perspective of student learning, then a major element of uncertainty exists that must be taken into account in the design of the system.

In general, the better the teacher understands how students learn the subject matter of the course, the more completely and definitively the conditions of learning may be specified.

The second major dimension of uncertainty with respect to student characteristics concerns variability among students. A class of students may vary along many dimensions, among the most relevant of which are abilities, motivation, and entry skills. No matter how much an instructor may know about how students learn a subject matter best, he must also understand how those students differ from one another in order to design the best system to accommodate to those differences; it is one thing to deal with a uniform population, and quite another to deal with a nonuniform population. Lack of uniformity introduces uncertainty which in turn requires greater flexibility.

Classroom Structure and Subject Matter

Another major element in the classroom that has a potentially significant impact on the design and structure of learning experiences is the subject matter itself. Every subject requires that students learn to make appropriate responses to various stimuli. One of the most important differences among various subject matters is the degree to which chains of stimuli and responses can be prescribed in advance. Stated in the form of a question: Do the tasks which students must learn have known approaches and solutions that can be laid down in advance, or is there a great deal of uncertainty in this regard? If the performance algorithms are known, then the instructor is in a better position to specify precisely what steps the student must take as he or she learns the task.

There is a second important question that must be answered with respect to subject matter, and this is the extent to which exceptions are apt to be encountered. Exceptions generally arise from the intrusion of unexpected, exogenous, environmental forces on the performance of a task. Even when students must learn highly prescribed skills, the number of exceptions may vary greatly across skills. In the execution of certain skills, such as the drive in golf, for example, there are few exceptions; but in team sports where one interacts continuously with other people, many exceptions are to be expected. A particular skill, such as throwing the forward pass, may be completely analyzable, but sometimes quarterbacks are forced to deviate from the prescribed form to "ground the ball" or throw it while falling.

This analysis suggests that, as a general rule, uncertainty will impact on the specification of what are commonly called methods and on the design of learning experiences within methods. The range of potential methods is, of course, very great; and there are countless variations within methods that are possible. Therefore, it would take us beyond the scope of the present paper to attempt to specify precise design criteria for every conceivable learning situation. However, it will be possible to summarize the implications of the general principle which was stated earlier. That principle held that the greater the uncertainty, the greater the flexibility one must be prepared to design into the classroom learning system. The principle is illustrated in Figure 1 which allows the instructor to estimate the contribution to uncertainty of the variables described in this section.

INSERT FIGURE 1 ABOUT HERE

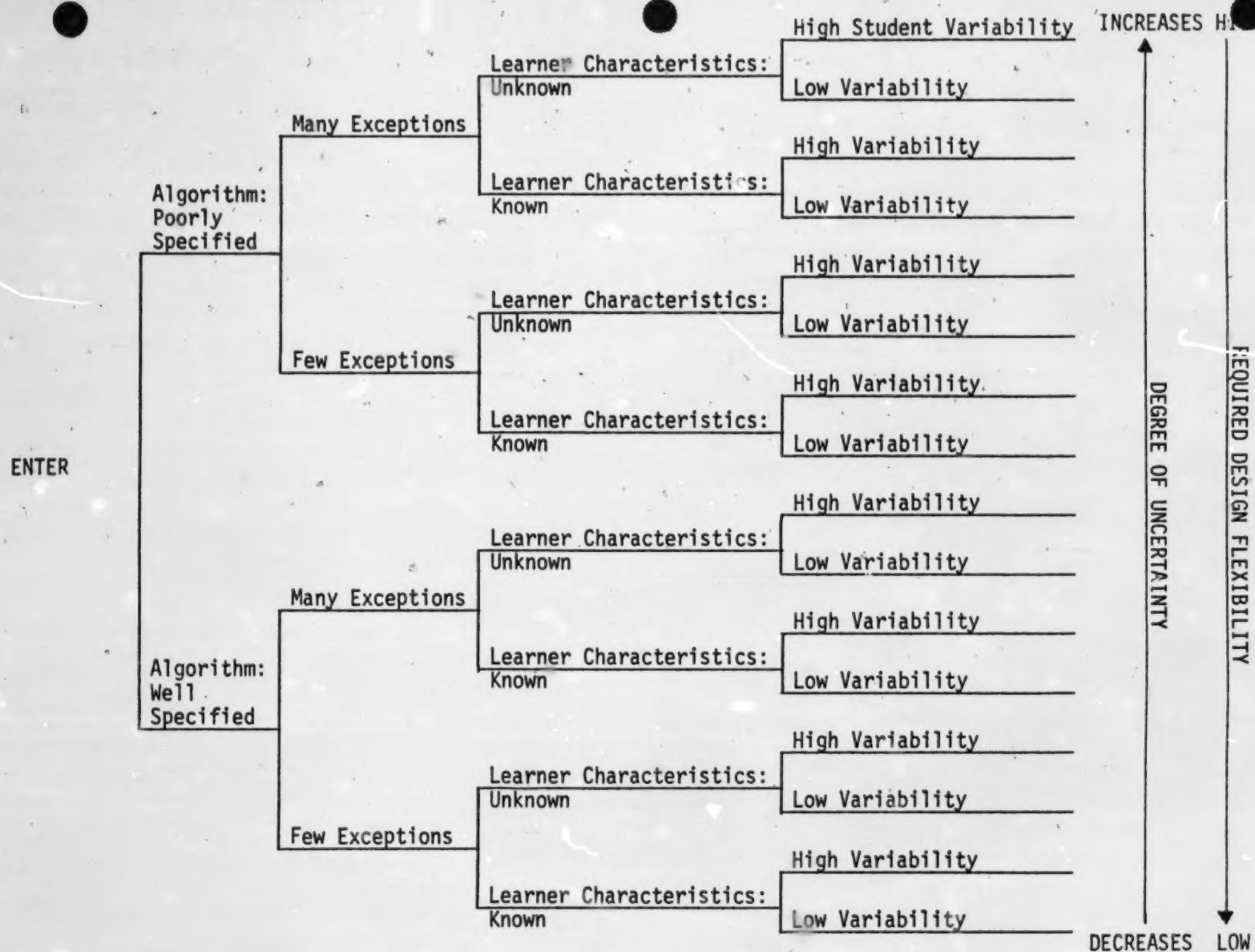


Figure 1. Model illustrating the effect of various students and subject matter characteristics on uncertainty and design flexibility. For caveats, see text.

In Figure 1 the characteristics of the subject matter and students have been brought together in the form of a model to predict uncertainty and required structural flexibility. At each of the branches in this tree the instructor answers a question about his or her subject matter or students. The four questions are drawn from the discussion of variances in this section. They are:

1. Can the algorithms that describe how students perform the activities taught in this course be specified fully?
2. As the students perform learned behaviors, will they encounter many or few exceptions?
3. How well do I (the instructor) understand how students learn the subject matter of this course?
4. Is the variability among students in skills, motivation, and ability in my course high or low?

By asking and answering each of these questions in turn, an instructor may gain a better feeling for the degree of uncertainty with which he or she must be prepared to cope and for the level of flexibility that should be designed into his or her classroom learning system. One caveat should be noted with respect to Figure 1. The figure treats these four critical variables as if they were dichotomous when, in fact, they are undoubtedly continuous. Although a computer program could easily be devised that would make continuous (as opposed to dichotomous) selection possible, it is difficult to see how this could be presented visually in the form of a figure, nor is it obvious that the increased precision gained thereby would be very useful. The model shown here is intended only to provide a rough indication of the degree of flexibility needed for different

levels of uncertainty and to reinforce the point made earlier that there is no one best way to structure any system, including learning systems.

A FINAL NOTE ABOUT THE QUALITY OF LIFE IN THE CLASSROOM

In an effort to make jobs more challenging and acceptable to workers, sociotechnical theorists have advocated the introduction of a number of innovations into the work place. These innovations offer workers greater variety of tasks, more autonomy, more social support and recognition, and more meaningful (whole or complete) units of work. Such changes have been urged because they improve the quality of working life and help to optimize the social side of organizations.

Some of the same conditions in the Western world that have led sociotechnical theorists to recommend changes of this type for factory workers have also had a major impact on students: rising levels of expectations, lower levels of tolerance for tasks that are boring or lack challenge, greater demands for individual autonomy, alienation from authority, and so on. If the classroom as a social system is to be optimized, instructors must take these conditions and their effect on students into account when they plan learning experiences.

There is a surprising parallel between the classroom and the factory in this regard, and many of the recommendations made for industry will, with minor modifications, fit the classroom situation. Like their counterparts in factories around the world, students need to work in an environment that offers them sufficient variety, challenge, autonomy, personal recognition, and dignity to maintain their motivation to accomplish their primary task, which is to change themselves into more competent and developed human beings.

Controlling one's own resources, capabilities, and activities, insofar as one is able to do so, is a source of deep satisfaction and potentially highly motivating. Although some students undoubtedly prefer to remain dependent, it is my impression that most of them aspire to full maturity, which necessarily implies accepting greater personal responsibility for their lives. Since individuals have different capacities in this regard, the demands made on them must be adjusted to their ability to handle them.

But however much or little responsibility instructors delegate to students, boundary management is crucial. Students must know what their responsibilities are and how they are to meet them. If the boundaries are unclear or if others are allowed to abuse established boundaries, by co-opted books or other learning resources, for example, then the result will be anger, frustration, and resentment. Furthermore, it may force students to adopt a dependent assumption in order to alleviate anxiety generated by uncertainty and, as I have already noted, dependence is antithetical to the ideal of the self-initiating learner. At the risk of being overly redundant, the instructor's role in this process is to define and regulate boundaries so that students may take responsibility for their own learning.

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